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ABSTRACT

The purpose of this followup electromyographical study was to gain further insight on previous research findings indicating that subvocal speech is significantly correlated with recall for preschool boys but not for girls. Twenty-two preschool children (11 boys, 11 girls; 50-67 months old) participated in 12 trials using high-labial and low-labial pictures as the stimuli. Each trial consisted of a stimulus presentation period (SPP), and a 20-seconds pre-recall delay period (DP). To facilitate comparison, the children were divided into four subgroups; younger and older boys and younger and older girls, all similar in IQ. The major findings showed that: (1) the older boys' subgroup was the only one that obtained significant correlations between recall and subvocal speech; (2) the young girls' subvocalization during picture presentation tended to occur independently of delay-period subvocalization, whereas young boys either subvocalized during both the picture presentation period and the delay period, or during neither period; (3) all four subgroups vocalized on almost all zero-recall trials; (4) 47% of the pictures not subvocalized by the younger girls were recalled; 25 to 27% of the pictures not subvocalized by older girls and younger boys were recalled, whereas, only 9% of the pictures not subvocalized by older boys were recalled. In conclusion, it appears that girls are relying upon methods other than subvocal speech to help them recall. (Author/MP)

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SEX DIFFERENCES IN THE RELATIONSHIP OF RECALL TO SUBVOCAL SPEECH IN PRESCHOOL CHILDREN

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SEX DIFFERENCES IN THE RELATIONSHIP OF RECALL TO SUBVOCAL SPEECH IN PRESCHOOL CHILDREN

The purpose of this paper is to gain further insight into an interesting finding in our previous research: Preschool-age boys apparently process information differently than do preschool-age girls.

In the first of our series of studies (Garrity, 1975) we sought to determine whether or not preschool-age children subvocalized during a short-term memory task and if so, whether there was a realtionship between amount of subvocal speech and recall proficiency.

The basic paradigm of the 1975 study was as follows: There were 10 trials, five using high-labial and five using low-labial pictures as the stimuli. High-labial words are those involving a great deal of lip movement (e.g., baby) and low-labial words are those involving a minimum of lip movement (e.g., girl) when silently pronounced. The degree of labiality was determined by the amount of electromyographical (EMG) activity measured from bipolar electrodes placed in the region of the lower lip muscle or orbicularis oris.

The high and low labiality conditions (which were equated for word familiarity) were introduced as a means of testing the possibility that any obtained EMG activity might be the result of artifact such as grimacing, heightened generalized muscle tension, etc. and not related to speech at all. Therefore, the conservative procedure was used of subtracting the EMG activity in the low from that in the high labial conditions for each

child: The remaining EMG activity (termed "subvocal speech") was then correlated with recall. Prior to the subtraction step, however, another conservative procedure was introduced: Each of the "raw" scores for the 10 trials was converted to T-scores to eliminate differences due to factors such as inter-subject differences in the relative distance between placement of electrodes, extreme EMG activity on a particular trial, etc. The T-scores for the high- and low-labial trials were then separately summed and the sum of the low-labial trial T-scores was subtracted from the high-labial trial values. All statistical procedures were based on T-score values.

Each trial consisted of a stimulus presentation period (SPP), a period in which each of three black and white line drawings of familiar objects were presented successively (each for 4 sec with a 1 sec inter-stimulus interval), and a 15-sec pre-recall delay period (DP). The individually tested children were instructed not to talk aloud, whisper, or move their lips, during both the SPP and the DP, and to sit quietly and remember the pictures during the DP. After the DP each child was asked to recall as many of the pictures from that trial as possible.

We found that preschool-age children did in fact subvocalize (there was a significant difference between high- and low-labial cordition T-scores), and that this subvocalization (in both the SPP and in the DP) was significantly related to recall, when the entire subject population of 46 children was statistically examined.

While analyzing various subject variables, however, we discovered an unexpected sex difference: The correlation between recall and subvocal speech was highly significant for boys both during the SPP and the DP--

but this was not the case for girls: Recall and subvocal speech were not significantly related for girls during either the SPP or the DP.

This finding could not be explained by sex differences in other important variables: Boys and girls were similar in total recall scores, in age, in IQ, and in total amount of subvocal speech (sum of high-labial minus sum of low-labial T-scores).

The above findings were replicated with 22 preschool-age children in a second study (Garrity & Donoghue, 1977), using similar procedures but conducted in a different setting with different experimenters and using a more difficult stimulus situation (e.g., 12 instead of 10 trials, 4 instead of 3 pictures per trial, and a 20 sec instead of a 15 sec SPP and DP duration).

In an attempt to gain more insight into the sex differences we conducted a series of further analyses, using the data from the 1977 paper and dividing the groups into young and old boys and girls. Since the sample size was 22 (11 boys and 11 girls), subgroups consisted of either 5 or 6 children, all similar in IQ (see Table 1 for a description of subject characteristics).

Insert Table 1 about here

We first wanted to see what the SPP and DP relationships between subvocal speech and recall were for young and old boys and girls (see Table 2). During the SPP moderate but nonsignificant correlations were found between subvocal speech and recall for young and old girls and for young boys, and a significant correlation for old boys. During the DP,

low, nonsignificant correlations were found between subvocal speech and recall for young and old girls and young boys, and significant correlations for old boys.

This indicated that old boys looked different than the other subgroups, particularly during the DP, and that young boys looked more like young and old girls than like old boys in the relationship of their subvocal speech and recall scores.

Insert Table 2 about here

These higher correlations for old boys cannot be explained for by greater EMG difference scores (sum of "raw" high-labial trial activity minus sum of "raw" low-labial trial activity): old boys and old girls engaged in similar amounts and young boys and young girls engaged in similar amounts (but lesser amounts than the older children). However, if, instead of looking at the difference scores, one looks at raw values for the high-labial trials and for the low-labial trials, separately, one finds that old boys engaged in more EMG activity on both the high- and low-labial trials during SPP and DP than the other three subject groups, 32% to 47% more than the other subject groups (see Table 3). This greater amount of EMG activity on both high- and low-labial trials is not reflected in the difference scores used in the statistical analyses, and it is unknown whether it reflects greater speech activity or greater amounts of non-speech artifact in both the high- and low-labial conditions. It was treated as artifact in all statistical analyses.

Insert Table 3 about here

An analysis was made of the serial positions recalled by the various age and sex subgroups (see Table 4). Both young boys and young girls evidenced relatively flat serial position curves across all four positions (within 3% to 7%). This is reflected in their pattern of subvocalization; each serial position appeared to receive about the same amount of EMG activity as every other.

There was a tendency for old girls to remember more of positions 1 and 2 than of positions 3 and 4 compared to old boys. Yet old boys and old girls appeared to subvocalize each of the 4 positions a similar amount during SPP. Therefore it is difficult to attribute differences in serial position of recall to differential SPP item subvocalization. It is unknown to what degree DP subvocalization may be involved since it was not possible to ascertain which items were being subvocalized during the DP by examining the paper record (since an instance of DP EMG activity could be associated with any of the four SPP pictures.)

Insert Table 4 about here

Those high-labial trials in which there was no EMG activity were examined for amount of recall (see Table 5). During the SPP, older boys and girls subvocalized on virtually every trial, hence the present analysis will pertain mainly to young girls and boys. Young girls did not subvocalize on 22% of the trials, and their recall was zero on only one-fourth

of these trials. (DP subvocalization occurred both with and without SPP subvocalization on one-half of the trials.) Young boys did not subvocalize during the SPP on 33% of the trials. On one-third of these trials recall was zero. (In the absence of SPP subvocalization, boys generally did not subvocalize during the ~~SPP~~ DP.)

During DP, older boys and girls also subvocalized on almost all trials. However, young girls did not subvocalize during the DP on 42% of the trials: zero recall was obtained on only 7% of these trials and SPP subvocalization occurred on the majority of these trials. Young boys did not subvocalize during the DP on 23% of the trials: on almost all of these trials there was some recall and there had been no preceding SPP subvocalization.

Thus, for young girls SPP subvocalization tended to occur independently of DP subvocalization, whereas for young boys, SPP and DP subvocalization tended to either occur or to not occur together. For all subgroups, on virtually none of the high- or low-labial trials was low SPP activity followed by high DP activity.

Insert Table 5 about here

Next, the relationship of zero recall to SPP and DP subvocalization was examined. Zero recall was obtained by young subjects on 23% of the trials and by old subjects on 10% of the trials. All sex and age subgroups subvocalized either during the SPP or the DP or both on almost all of the zero-recall trials.

A related question is: of the total number of items recalled, how many of the items were not subvocalized (see Table 6)? For young girls, 47% of the items not subvocalized were recalled; for old girls this was 27%; for young boys, 25%; and for old boys 9%. In other words, 91% of the pictures recalled by old boys were subvocalized in the SPP; 73% to 75% of the items recalled by old girls and by young boys were subvocalized; and only 53% of the items recalled by young girls were subvocalized.

Of the items that were recalled but not subvocalized during the SPP, 75% of these were in positions 3 and 4 for young females; 75% were in positions 2 and 4 for the young boys; 79% were in positions 1 and 2 for old girls; and 60% were in position 4 for the old boys.

Insert Table 6 about here

In conclusion, based upon the various types of analyses described above, it appears that girls are indeed relying upon methods other than subvocal speech to help them recall. It is hoped that future research concurrently measuring visual in addition to verbal processing of information would provide more insight on this subject.

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TABLE 1

DESCRIPTION OF SUBJECT CHARACTERISTICS

Subject Groups	M	Age (in mos)	IQ	Free Recall* (Total possible = 48)
Boys				
Young	5	50	116	16
Old	6	66	118	25
Girls				
Young	6	50	113	15
Old	5	67	113	26

* Free recall was used in all analyses since correlations between ordered and free recall were high, ranging from 0.96 to 0.98.

TABLE 2

CORRELATIONS BETWEEN FREE RECALL

AND SUBVOCAL SPEECH t-RATIOS

(FOLLOW-UP STUDY)

Group	Trial Period	Correlation	Age (mos)	Mean Free Recall
Young Girls	SPP	.493	50	15
	DP	.003		
Old Girls	SPP	.796	67	26
	DP	.275		
Young boys	SPP	.516	50	16
	DP	.288		
Old Boys	SPP	.820*	66	25
	DP	.830*		

* $p < .05$

TABLE 3

μV VALUES PER SUBJECT PER 20 SEC TRIAL SEGMENT

Subject Group	Stimulus Presentation Period		Delay Record	
	High Labial Trials	Low Labial Trials	High Labial Trials	Low Labial Trials
Young Girls	3324.0	2265.3	2442.0	1340.4
Young Boys	2881.2	1905.3	2182.5	2486.4
Old Girls	3557.4	2026.2	2888.4	2024.7
Old Boys	5063.7	3214.8	4113.6	3461.4

NOTE: μV values are based on the summed amplitude of the five highest pen deflections in each 20 sec trial segment (i.e., SPP or SP).

TABLE 4

SERIAL POSITION OF RECALL CURVES

BY AGE AND SEX SUBGROUPS

Group	Serial Position 1	2	3	4
Young Boys	28%	25%	21%	26%
Young Girls	25%	20%	25%	30%
Old Boys	50%	40%	47%	68%
Old Girls	65%	57%	37%	58%

NOTE: Percentages are based on total recall for each of the four subject groups.

TABLE 5

DESCRIPTIVE ANALYSIS OF HIGH-LABIAL TRIAL SPEECH

EMG ACTIVITY (NOT CORRECTED FOR NONSPEECH ARTIFACT)

Group	No Activity in SPP or DP		No SPP Activity, but DP Activity		No DP Activity, but SPP Activity		Activity in SPP & DP	
Recall	0	+	0	+	0	+	0	+
Old Boys	3					6	11	81
Old Girls						3	7	90
Young Boys	3	20	7	3	3		7	57
Young Girls	3	8	3	8	3	31	17	28

NOTE: Figures are based on percentages of trials.

TABLE 6

THE RELATIONSHIP BETWEEN EMG ACTIVITY DURING STIMULUS PRESENTATION (SPP) AND RECALL

Subject Group	No EMG Activity during SPP	Some EMG Activity during SPP
Old Boys	9%	91%
Young Boys	25%	75%
Old Girls	27%	73%
Young Girls	47%	53%